

HYDROGEN SULFIDE

CAS Registry Number: 7783-06-4

H₂S

Molecular Formula: H₂S

Hydrogen sulfide is a colorless, flammable, poisonous gas with a rotten eggs odor. It burns in air with a pale blue flame. Hydrogen sulfide gas corrodes metals. Hydrogen sulfide is soluble in water, alcohol, ether, and glycerol. Water solutions of hydrogen sulfide are not stable, and because absorbed oxygen causes the formation of elemental sulfur, the solutions become turbid (Merck, 1989). The liquid form is stable at room temperature.

Physical Properties of Hydrogen Sulfide

Synonyms: sewer gas; stink damp; sulfurated hydrogen; sulfur hydride; hydrogen sulfuric acid

Molecular Weight:	34.08
Boiling Point:	-60.4 °C
Melting Point:	-85.5 °C
Density/Specific Gravity:	1.539 g/L at 0 °C (water = 1)
Vapor Pressure:	20 atm at 25.5 °C
Vapor Density:	1.189 (air = 1)
Autoignition Temperature:	260 °C
Conversion Factor:	1 ppm = 1.39 mg/m ³

(Merck, 1989; Sax, 1989)

SOURCES AND EMISSIONS

A. Sources

Hydrogen sulfide is emitted during the burning of sulfur-containing fuel oil and coal and wherever organic matter undergoes putrefaction. It is also emitted from industrial paper plants using the kraft process. It may also be generated by the leather industry, which uses sodium sulfide to remove hair from hides prior to tanning. Large quantities are used in the production of heavy water for nuclear reactors. It is also used in the manufacture of chemicals, in metallurgy, and as an analytical reagent (Amdur et al., 1980; Sax, 1987).

The primary stationary sources that have reported emissions of hydrogen sulfide in California

are electrical service companies, oil and gas extraction operations, and steam and air conditioning supply services (ARB, 1997b).

B. Emissions

The total emissions of hydrogen sulfide from stationary sources in California are estimated to be at least 5.6 million pounds per year, based on data reported under the Air Toxics “Hot Spots” Program (AB 2588) (ARB, 1997b).

C. Natural Occurrence

Hydrogen sulfide occurs in coal pits, volcanic gases, natural gas wells, sulfur springs, and in decaying organic matter containing sulfur (Merck, 1989).

AMBIENT CONCENTRATIONS

No Air Resources Board data exist for ambient measurements of hydrogen sulfide.

INDOOR SOURCES AND CONCENTRATIONS

No information about the indoor sources and concentrations of hydrogen sulfide was found in the readily-available literature.

ATMOSPHERIC PERSISTENCE

In the troposphere, hydrogen sulfide will exist in the gas phase, and the dominant gas phase chemical loss process will be by reaction with the hydroxyl (OH) radical. The calculated half-life and lifetime of hydrogen sulfide due to reaction with the OH radical are 2.1 days and 3.0 days, respectively (Atkinson, 1995).

AB 2588 RISK ASSESSMENT INFORMATION

The Office of Environmental Health Hazard Assessment reviews risk assessments submitted under the Air Toxics “Hot Spots” Program (AB 2588). Of the risk assessments reviewed as of December 1996, for non-cancer health effects, hydrogen sulfide contributed to the total hazard index in 14 of the approximately 89 risk assessments reporting a total chronic hazard index greater than 1, and presented an individual hazard index greater than 1 in 4 of these risk assessments. Hydrogen sulfide also contributed to the total hazard index in 29 of the approximately 107 risk assessments reporting a total acute hazard index greater than 1, and presented an individual hazard index greater than 1 in 21 of these risk assessments (OEHHA, 1996b).

HEALTH EFFECTS

The most probable route of human exposure to hydrogen sulfide is inhalation.

Non-Cancer: Acute high-level exposure to hydrogen sulfide can cause immediate respiratory arrest (ACGIH, 1992). It has been reported that hydrogen sulfide exposure is the most common cause of sudden death in the workplace (NIOSH, 1977). Hydrogen sulfide can irritate the eyes and respiratory tract, with pulmonary edema following longer exposures. The mechanism of hydrogen sulfide toxicity, cellular hypoxia caused by inhibition of cytochrome oxidase, is similar to that for cyanide. Symptoms include headache, nausea, vomiting, and cough (NRC-EEGL, 1985).

The National Academy of Sciences Emergency Exposure Guidance Level for hydrogen sulfide is 70 milligrams per cubic meter (mg/m^3) for 10 minutes (NRC-EEGL, 1985). Exposure to $70 \text{ mg}/\text{m}^3$ for 1 hour is reported to cause conjunctivitis with ocular pain, lacrimation, and photophobia; this can progress to keratoconjunctivitis and vesiculation of the corneal epithelium (ACGIH, 1992). At concentrations exceeding $70 \text{ mg}/\text{m}^3$, olfactory fatigue prevents detection of the “rotten egg” odor. The 1-hour California Ambient Air Quality Standard for hydrogen sulfide is $0.042 \text{ mg}/\text{m}^3$ (ARB, 1984b).

An acute non-cancer Reference Exposure Level (REL) and a chronic non-cancer REL of 42 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) are listed for hydrogen sulfide in the California Air Pollution Control Officers Association Air Toxics “Hot Spots” Program, Revised 1992 Risk Assessment Guidelines. The central or peripheral nervous system is the primary target system of concern for chronic toxicity. The toxicological endpoint considered for acute toxicity is the respiratory system (CAPCOA, 1993). The United States Environmental Protection Agency (U.S. EPA) has established an inhalation Reference Concentration (RfC) of $1 \mu\text{g}/\text{m}^3$ for hydrogen sulfide (U.S. EPA, 1995b).

Cancer: Hydrogen sulfide has not been evaluated for carcinogenicity by the International Agency for Research on Cancer or the U.S. EPA (IARC, 1987a; U.S. EPA, 1995a).

